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FEATURES

THE HYPACT BURNER. By J. C. Salmon and F. C. Forder.

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Editorial

It's all in the burner

ANY assistance which can be given to the industrial gas engineer in his efforts to improve industrial gas burning equipment is always of value both to him and also to the industrialist.

The Hypact burner is one such aid and we are publishing this month a description of its main applications and advantages in a paper by Mr. J. C. Salmon and Mr. F. C. Forder, both of whom are industrial engineers of the North Thames Gas Board.

The outstanding points about this particular type of burner are its simplicity, its very great turn-down range and its ability to concentrate great quantities of heat in a comparatively small flame. Added to these are its high degree of flame stability and the ease, and therefore the low cost, of its construction.

How can these particular qualities that we have outlined, contribute to the outstanding advantages claimed by the authors? Can a post-aerated burner such as this be so much more effective than the more usual pre-aerated burner? In the past the development of the latter type would seem to have made possible higher furnace temperatures, so the claims made for this post-aerated burner might at first sight appear to be a little extravagant.

On further investigation, however, it is at once clear that the Hypact burner is of the utmost use for converting industrial furnaces burning another fuel to gas firing with the minimum of structural alterations. This is a point brought out in the paper since the authors made it clear that in at least one case, had they been designing a new furnace specially for gas, they might well have fitted some other burner.

The great concentration of heat in a flame of unusually small size makes it possible to adapt existing combustion chambers to gas ignition so that the maximum degree of radiation may be utilised from the flame and the fullest possible use made of the sensible heat in the flue gases. Conversions of this type are the substitution of solid fuel fired boilers for hot water or steam raising to gas firing. This property of heat concentration is made use of in an improved type of 'gas poker' for lighting up solid fuel fired steam raising boilers, and also, combined with the ability to burn in the open air, in the design of gas-burning flambeaux to be seen in the Battersea Festival Gardens.

The great stability of the flame even in a draught of some magnitude is particularly valuable when designing hot air heaters since it makes possible direct air heating by which heated air combined with hot waste gases may be concentrated on the object to be dried; the quantity of such heated air available is unlikely to be so great from a plant of equal size fired by other means.

The Hypact burner is then a particularly useful tool to the industrial gas engineer and the industrialist alike, since it enables the former to fully implement his claims to gas conversion and affords the latter the enjoyment of the benefits of gaseous firing at the minimum expense.

THE HYPACT BURNER

By

J. C. Salmon and F. C. Forder,

INDUSTRIAL GAS ENGINEERS,
NORTH THAMES GAS BOARD.

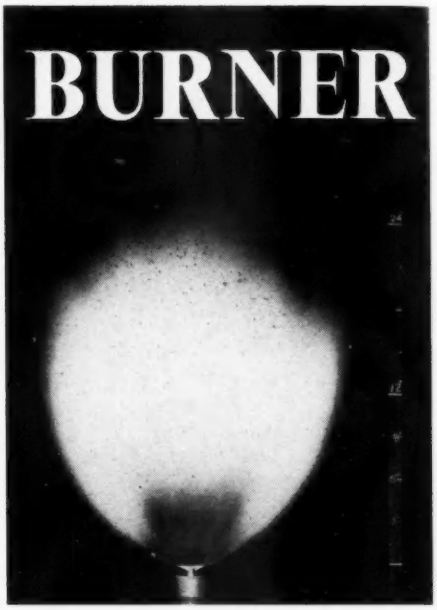

Fig. 3

THE Hypact burner provides a means of burning gas in a relatively small flame by means of a simple and cheap design of burner head that can operate under all normal pressure conditions of gas supply and forced draughts. Premixing of the gas and air is not necessary. Since its introduction it has been used in many varied applications and it has now been accepted as a very valuable tool of the industrial gas engineer and appliance manufacturer.

The first experimental range of sizes was made from mild steel sheet and is shown in Fig. 1. These experimental burners were fabricated in such a way that the inner surfaces of the flat flame jet were reproduced but with linear magnification and since the walls were of thin metal sheet they ably illustrate, by their external appearance, the general design of the 'industrial' jets.

The gas way approaching the burner head is tapered, changing from a circular cross-section to that of an elongated rectangle. The long narrow slot forming the head to the gas way has an outlet in its centre where part is extended down to a level just short of the apex. This extension is intersected by a transverse slot extending from the outer surface. The outer slot itself is wedge shaped along its major axis.

The flow of gas appears to be guided towards the two shoulders formed by the long tapering section and then to divide into two streams, each turning at right angles towards the central slot. The two resultant streams of gas impinging against each other in the centre of the slot fan out to give a broad flat flame with a thin cross section.

Each size of burner in the range was given a number which also indicated the gas rate that would be passed with a gas pressure of 1 in. w.g. and a specific gravity of .5 (air=1). It was found that calculation of gas rates to be expected at other gas pressures could be made by multiplying the burner number by the square root of the pressure under consideration. Therefore a No. 60 Hypact burner passing 60 cu.ft. per hour of gas at 1 in. w.g. pressure would pass $60 \times \sqrt{2.5}$ or 95 cu.ft. per hour at 2.5 in. w.g. burner pressure.

Similar to 'industrial' jets

The flames from these experimental mild steel sheet Hypact burners were very similar in shape to those obtained from the smaller 'industrial' jets, but proved to be apparently different in nature. The 'industrial' jet produces a smooth gentle flame with little noise, indicating a streamline flow under normal working conditions of gas pressure. Increasing the gas pressure will, according to jet size, give rise to a noisier flame which would, on a further slight increase of the gas pressure, result in the lifting of the flame from the burner, followed immediately by extinction.

By the turbulent nature of the gas flow from the Hypact burner, together with the comparatively high degree of air entrainment, the flame at normal working gas pressures is comparatively small in volume for the amount of gas being burned. Its aeration under these conditions, makes flame impingement without soot deposition possible. The wide, short, but thin flame shown in Fig. 2 is typical in shape of those produced by the smaller 'industrial' jet. A softer, luminous flame obtained with the same range of burner sizes but at a much lower gas pressure is obtained when flow is probably streamline. With the larger sizes there is a loss of width in the flames due to a reduction in the angle of the discharging gases, but their heights are virtually unchanged and this has been a feature of these burners. Once the flame shape is fully developed, usually at a low pressure, then there is no substantial lengthening of the flame with increased gas pressure right up to the extinction point.

The Hypact burner offers a stable flame even under conditions when the flame has lifted from the burner or is subjected to a strong current of air blown across it. Flame stability under these forced draught conditions immediately suggested the use of these burners in direct fired air heaters where the air to be heated passes around the burner and mixed with the produets of combustion is carried forward.

The preliminary examination of these burners indicated that they could be usefully employed in industrial equipment, particularly in vessel heat-

This article is an abstract of a paper to the London and Southern Section, Institution of Gas Engineers.

ing. If so, their manufacture from mild steel sheet would neither be sound, economical or practical. The labour charges to mark out, cut and weld the various sections could not be justified even though with quantity production a certain amount of tooling could be used. Further, the effect of oxidation on the burner caused by heat from back radiation in the combustion chamber would have shortened its life.

An attempt to reproduce

In an attempt to reproduce these burners in cast iron by green sand moulding, the No. 600 size, Fig. 3, was made. This was fairly successful but was heavy, and the accuracy in placing the core to get clean regular shaped shoulders was important. It was also essential to remove the remains of the core completely from the shoulders to ensure a repeatable gas rate and a regular flame shape. These requirements became very critical when the Nos. 60 and 125 sizes were cast in this way. The smallness and the great importance of obtaining the correct dimensions requiring castings with a small linear tolerance ruled out this production method.

At the same time as trials on the small cast burners were proceeding, attempts were being made to reduce the weight of the cast No. 600 burner. The tapered approach of the gas way was shortened by one half, by three-quarters and finally eliminated completely except for that required to form the shoulders. The flame from the resultant burner fabricated from mild steel sheet, when compared with that obtained from a similar experimental burner, working under the same gas pressure, was practically unchanged in shape. This indicated that shorter and lighter burners could be made with a reduction in costs.

Manufacture and sale

At this stage the Aeromatic Co. Ltd., now at Eskdale Road, Uxbridge, undertook the manufacture and sale of these burners. Their first burners were made from a flat circular disc cast by the shell moulding technique introduced at about that time. A casting with considerably smoother surfaces and greater accuracy of reproduction was possible, which was then fitted into a B.S.P. screwed socket to form a burner. Although this enabled the weight to be reduced even further, difficulties arose in producing the smaller sizes, particularly with the accurate registration of the mould sections. This manufacturing approach, however, led the Aeromatic Company to produce the present design of Hypact burner shown sectionally in Fig. 4, in the size range indicated in Fig. 5.

The burners now consist of a mild steel disc milled with two principal slots; one of regular shape to form the internal shoulders of the gas way and the other from the reverse face to form the guiding surfaces for the expanding streams discharging from the burner shoulders. The disc is then welded into a suitably modified B.S.P. socket and the appropriate number for the size is stamped on the surface of the milled disc. A light and compact burner is therefore possible; for example, a No. 1,000 size capable of passing 1,000 cu.ft. per hour of gas at 1 in. w.g. pressure is made from a 2 in. B.S.P. socket and weighs only about 3 lb. For severe oxidising conditions these burners are available with a chromised finish.

For use under high temperature conditions where the life of a metal burner would be very short, burners moulded in refractory materials such as silicon-ester bonded sillimanite and zircon, have been successfully used.

It is estimated that about 4,000 Hypact burners are made and put into commission in the course of a year. In the absence of any wide survey it is not possible to give precise details of all the different purposes for which these burners are used.

It is proposed to deal first with those applications in which the burner is not fitted to an appliance in the conventional manner, but in which the properties of lightness, flame stability and small size in relation to heat output

Fig. 2

are exploited. These properties have led to the Hypact burner being used as a torch in the preheating of moulds, ladles, and other objects as well as the rollers in rolling mills. In some of these cases the burners will be made moveable, and the gas supply run in flexible tubing; the need for a single hose and a simple cock as a controller is an obvious advantage over other forms of torch. Where a number of objects of similar size, such as foundry ladles, are to be heated, the Hypact burner is arranged to fire vertically upwards through a central opening in a flat horizontal refractory table,

Fig. 1

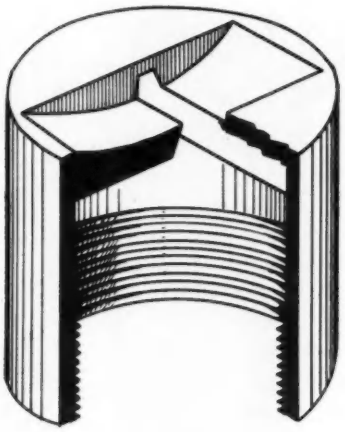

Fig. 4

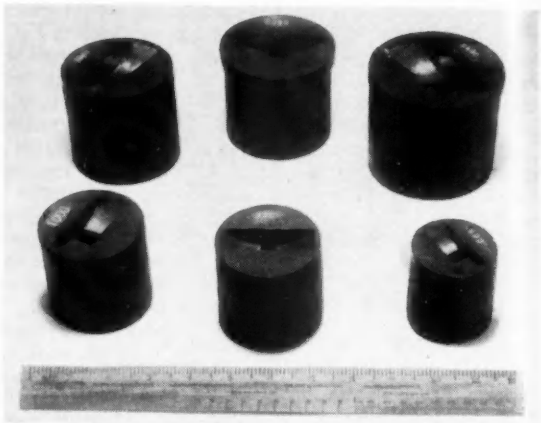

Fig. 5

the inverted ladle being suspended above the burner. Tables with any desired number of heating stations may be made up in this manner.

Two interesting cases

Two other interesting cases demonstrating the flame stability of the Hypact burner under adverse conditions may be cited here. The first was the decorative clusters of burners made made up as flambeaux which were used during successive years at the Battersea Festival Gardens—a typical arrangement is shown in Fig. 6 —the other was the fitting of a burner in an underground brick duct, 3 ft. 6 in. by 2 ft. 6 in. in section, which carried the products of combustion containing a high concentration of sulphur to a factory chimney 150 ft. in height.

The purpose of this burner was to ensure that the products would pass through the flame and so be finally discharged into the atmosphere as sulphur dioxide, instead of hydrogen sulphide. The burner and air entry passage were easily fitted by attaching them to a plate replacing an existing inspection cover.

One of the more common uses for the Hypact burner is in the kindling of the fires in solid fuel burning appliances, which range in size from small domestic coke-fired boilers to Lancashire boilers and railway locomotives. It is the suitability of the flame shape and the small size of the burner in relation to the gas rate which have greatly contributed to its adoption in this field. Initial experiments showed that the most convenient way of lighting the fires in sectional coke-fired boilers was, if possible, to arrange for the burner to be positioned in the ashpit of the appliance and the flame to fire upwards and backwards through the grate bars.

An attempt to standardise burners for this purpose resulted in the arrangement shown in Fig. 7. It consists of a rectangular cast iron base into which is screwed a vertical mild steel rod fitted with a clamp carrying a horizontal length of tubing. To this

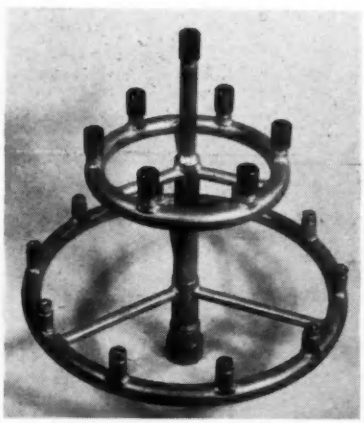

Fig. 6

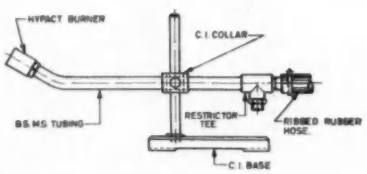

Fig. 7

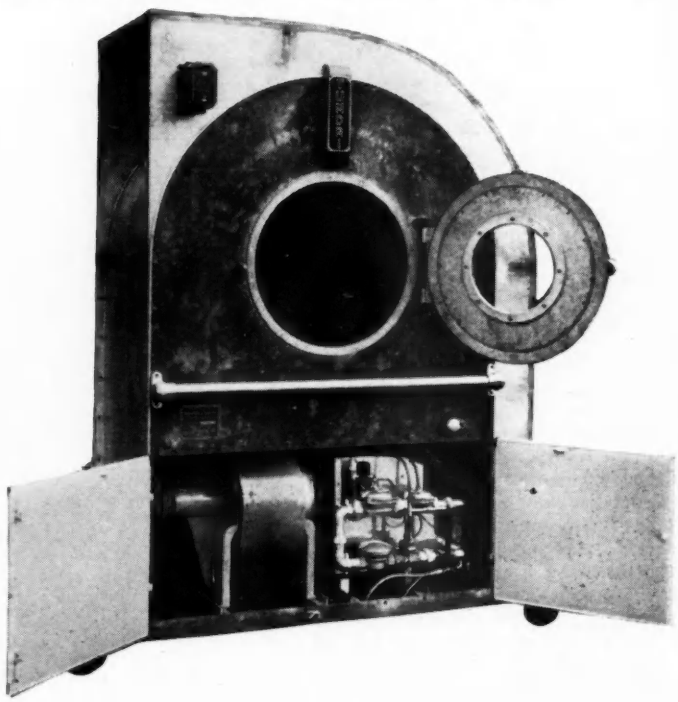

Fig. 8

the burner is attached, and the gas connection to the unit is made by means of a length of flexible hose.

The burner is lighted at a low gas rate and then so placed that the horizontal tube to which the burner is fixed passes through the ashpit door of the boiler. The gas rate is then increased to the full amount and the burner is withdrawn as soon as the fire has ignited. Similar appliances have been made for vertical steam raising boilers with grates measuring up to 4 ft. in diameter, but with the burner arranged to fire vertically upwards. Experience has shown that one very large burner gives better results than when a number of smaller ones are used.

No rules for the determination of the burner size can be given since this will depend on the fuel used, the flue conditions, the time to be allowed for ignition and the size of the gas supply available. A particular advantage which the Hypact burner has in this field, is the ease with which a burner can be exchanged for one of another size, should the first estimate be found incorrect.

In dealing with some very large horizontal central heating boilers, Lancashire boilers and railway locomotives, where firing through the grate bars was either impossible or inconvenient with the old type aerated burner, Hypact burners have been arranged so that the flame would impinge directly on to the solid fuel.

Application to incinerators

Following the ignition of solid fuel boilers the application of the Hypact burners to incinerators was a natural step. Here the burner could be rigidly fitted in a position where it could fire through the grate bars, while auxiliary burners fitted at a higher level could fire downwards on to the material to be burned.

A great number of Hypact burners are used in air heating units of one form or another. A simple form of direct fired air heater consists of a chamber with a mild steel frame and outer casing with the burner fitted inside a deflecting screen of perforated mild steel sheet which serves to keep the outer casing cool and to give direction to the flame. Air from a fan enters at the base of the unit passing through the combustion chamber and the resulting mixture of air and products of combustion pass from the top of the unit into ducting to be used for the process.

Air heaters of this type have been made with gas rates varying from 2 to 3 therms per hour and with air rates of between 700 and 1,100 cu.ft. per minute. Should the re-circulation of the hot air and products be desired, the Hypact burner is fitted into a section of the ducting which may need to be enlarged in order to accommodate the flame. An example of this type of heater would find use in such applications as the heating of rooms and ovens.

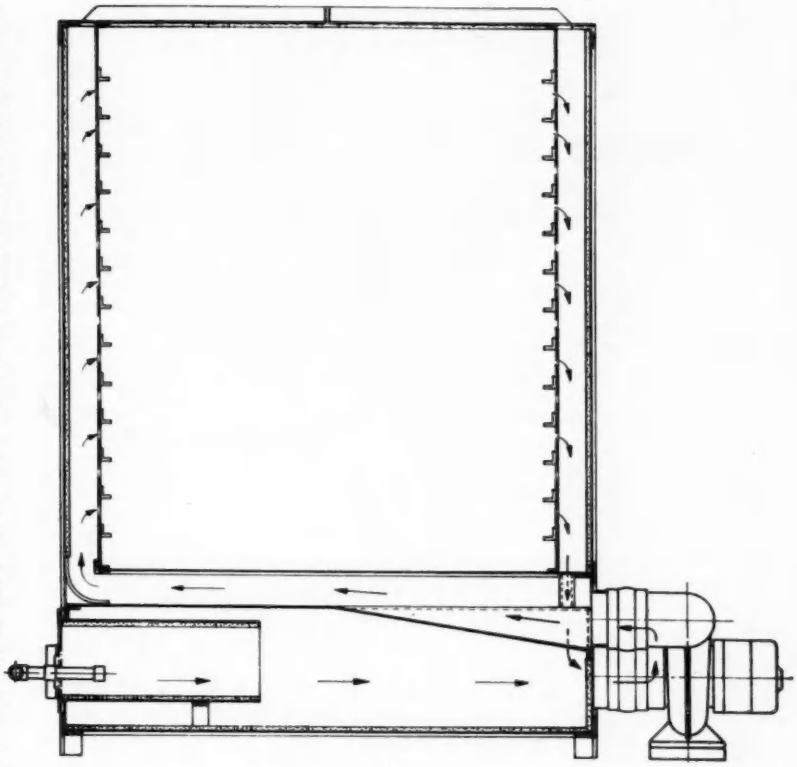

Fig. 9

Another variation of this system was a steam-heated rotary tumbler for use in a laundry, which was to be converted to gas operation. By substituting the existing heat exchanger fitted on the fan inlet, by a short length of ducting into which a Hypact burner was arranged to fire, no modifications to the exterior casing of the unit were needed, as illustrated in Fig. 8.

The natural development of this has been the design of a number of direct fired ovens with air circulation using the Hypact burner.

Fig. 9 shows an oven with the combustion space lying between the working chamber and the floor. For a single Hypact burner arranged to fire into this space, the hot air and products of combustion are withdrawn by the fan and passed under the oven and into the vertical cavity between the outer and inner casings. A series of openings in the inner casing allows passage across the oven to similar openings in the opposing wall into which the hot products are drawn since the space between this wall and the outer casing is connected to the combustion chamber. A number of ovens operating on this principle have been made with varying positions for the burner fan and combustion chamber.

Floor available for trolleys

In another design the combustion space was positioned above the oven, leaving the floor available for the passage of the trolleys containing the work to be treated, while yet another was arranged to accommodate burner, combustion chamber and fan in a casing, rectangular in section. Air entry and exit ports were in the base running across the width of the unit, which was mounted above an existing conveyor belt.

The stabiliy of the Hypact burner at very low gas rates in a moving air stream is of extreme importance in the application of ignition and flame protection devices. Instead of having to provide a separate pilot burner for the ignition of the main burner, the pilot supply may be so arranged to feed the main Hypact burner head, thus ensuring greater safety and reliability in operation. Though this is of particular advantage where the Hypact burner is applied to air heaters, it

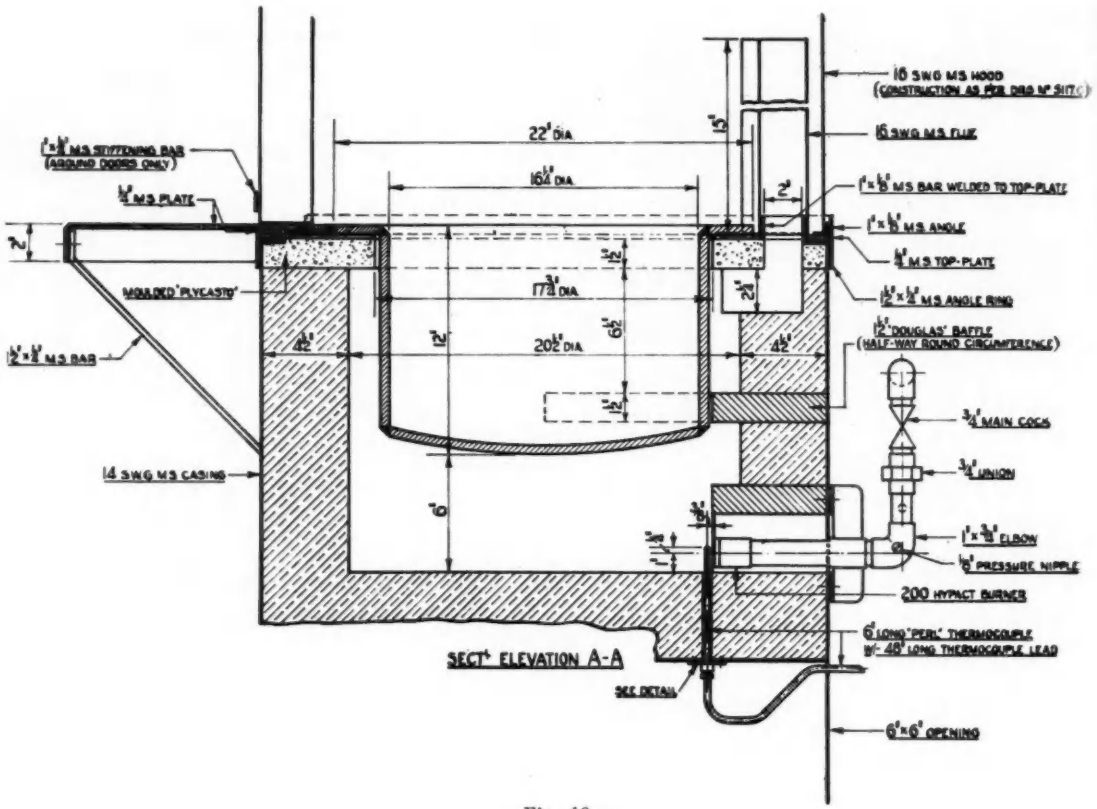

Fig. 10

has tended to become standard practice where flame protection devices are to be fitted.

These characteristics of small size and stability at low gas rates, make the Hypact burner particularly suitable for the heating of vessels containing liquids or the melting of metals. The increased use of thermostatic control equipment and flame protection devices has also led to the greater use of the Hypact burner in this type of apparatus.

Applied to crucible preheater

In its simplest form it was first applied to a crucible preheater and consisted of a vertical lined cylinder which held the crucible and a Hypact burner centrally positioned in the base firing vertically upwards. The products were discharged through an opening in the refractory lid. This unit could be successfully used for metals with melting points up to that of aluminium.

As to how the Hypact burner may be applied to metal melting furnaces depends on whether there is an opportunity of designing the appliance. In a great number of instances the provision of a reliable burner system is called for to replace obsolete equipment, or to convert an appliance from solid fuel firing, but continuing to use the existing melting pot and casing.

A sectional view of a small soft metal melting furnace shown in Fig. 10 may be considered as the basic method of firing for cylindrical vessels; pots with capacities of up to 8 tons of lead fitted with No. 2000 burners have been dealt with in this way. The burner fires horizontally across the floor of the combustion chamber; the gas supply to the burner passes through a rectangular opening serving as the air inlet and its position is registered by the supporting bracket attached to the outside of the casing.

By suitably arranging the siting of the burner in relation to this inlet, the minimum dilution of the products can be achieved. The horizontal semi-circular brick baffle fitted close to the pot with its centre line immediately above the burner ensures that the products of combustion will have the greatest travel over the outer surface of the pot before being discharged through the flue outlet, the centre line of which is directly above that of those of the baffle and burner.

In Fig. 10, the flue is taken off through the top plate upon which the flange of the pot rests. The flue gases could have been discharged from the side of the casing near the top, but it might not have been convenient for the flue to be immediately above the burner, since it is generally positioned nearest to the wall of the room in which the appliance is fitted; it is in fact often so close to the wall that the lighting up of the appliance is very difficult or even impossible. Where this is so the centre line of the flue is moved only as much as will allow access to the burner, the relative positions of the baffler and burner remaining unchanged. Where the permissible height of the combustion chamber is limited, or where the pot diameter is very great, it is common practice to use two burners, each with its own air entry port, to give the requisite gas rate.

Alternative arrangement of burner

Should it not be possible to fit a brick baffle in a furnace of this kind, the burner would be arranged to fire horizontally or slightly downwards on to a bed of broken refractory material on the floor of the combustion chamber and heaped up against the wall opposite. This will allow the wide flame of the Hypact burner to heat the maximum area of broken refractory and increase the heat transfer to the vessel by radiation.

The application of the Hypact burner to metal pots which are rectangular in section will in general follow the

same lines as the foregoing, but the case of a tinning bath 2 ft. square in plan, and 3 ft. in depth, is of interest. Experience with vessels of this shape has shown that if heat is applied to the cold full vessel on the underside only, there is a risk that molten metal from the lowest zone may force its way up through weak parts in the solid mass above it and spurt from the bath. To overcome this hazard, a single No. 200 Hypact burner was provided to fire upwards on either side of the bath while the main burner, a No. 400, fired along the base. Another tinning bath with an inner container measuring 10 ft. long by 12 in. by 15 in. in cross section and used for the continuous tinning of strip, was originally fired by low pressure aerated burners. Eight No. 200 Hypact burners were substituted in order to give flame stability at low gas rates and to simplify the provision of flame protection devices.

Where the Hypact burner is to be applied to the heating of liquids in tanks of rectangular section, the method of firing is very much the same as that used for heating vessels of similar shape operating at higher temperatures. When, however, the fitting of an outer casing is not permitted, heating can be arranged by the construction of a lined framework, with the Hypact burner or burners firing along the base of the vessel from one end with the flue offtake positioned at the other end.

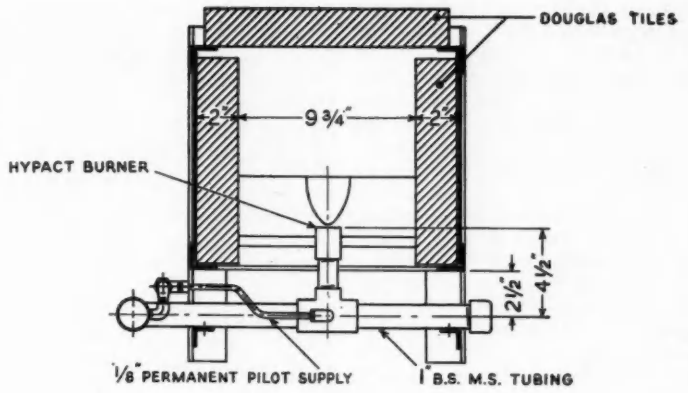

Fig. 12

The Hypact burner provides a ready means of converting solid fuel appliances to gas operation, but their thermal efficiency will not be as high as it would have been in an appliance specifically designed to burn gas. Against this can be set the saving in capital cost, the labour charges incurred in providing a skilled stoker to operate the solid fuel appliance, and the convenience of not having to store the fuel for an appliance which may only be used intermittently.

This applies particularly to steam raising and hot water boilers, where the conversions have been simply carried out by lining the existing firebox with brickwork, covering the grate bars and replacing the ash door by a plate carrying the Hypact burner with its own entry port. Crosstube, and both vertical and horizontal multitubular boilers have been converted in this way.

Successful in steam raising unit

A steam-raising unit in which the Hypact burner has been proved particularly successful is the 'Hypressure Jenny' in which water is pumped at the rate of 1 gal. per minute through a length of ¼-in. iron pipe about 100 ft. long, arranged in three concentric coils.

In passing through the coil the water is heated in a stream of air from a fan by means of a No. 600 Hypact burner running at a gas rate of 5 therms per hour. Attaining a working pressure of 100 to 130 p.s.i.g. the heated water is led through a flexible hose to a gun where the pressure is released through a control valve, from which the high velocity spray of steam and water is directed against objects to be cleaned. The arrangement of the burner and coil are shown in Fig. 11.

The replacement by a Hypact of the air blast burners in a small gas fired forge is an excellent example of the advantage to be gained from this burner's compactness and flame intensity. The forge, used for the heating of tubing and mild steel sections prior to bending, originally consisted of two opposing air-blast burners playing on the work to be heated, which was laid on a hearth covered with broken refractory material. Since

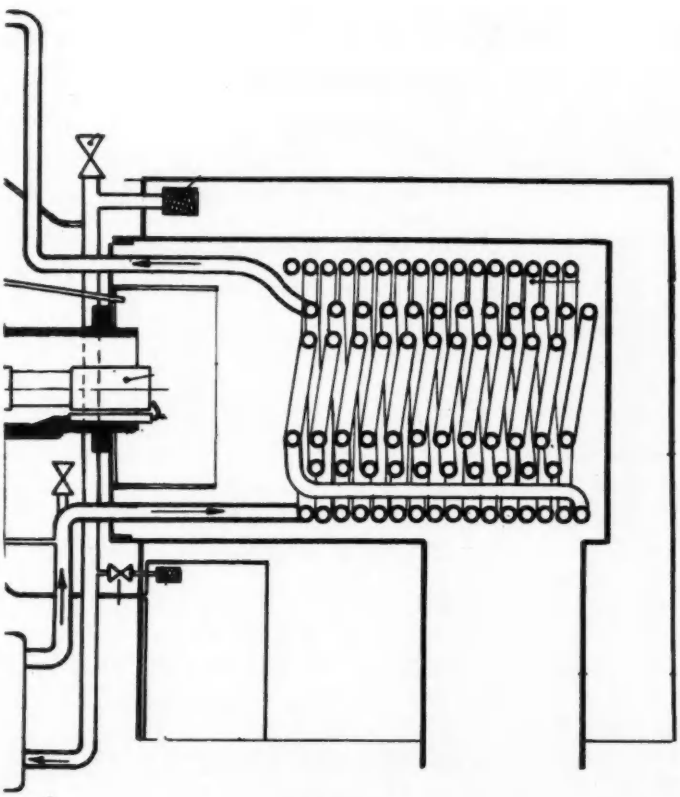

Fig. 11

this particular forge is used in small workshops where air supplies are rarely available, the majority of air-blast units are fitted with hand operated blowers. Two men would therefore be needed to carry out the heating operation, one being occupied in operating the blower. The two existing burners were first dispensed with and this was followed by re-making the hearth in two sections with a central gap placed at 90° to the direction in which the work would lie. Positioned centrally in the gap was a single No. 125 Hypact burner arranged to fire upwards on to the work as it lay slightly above the hearth level, and supported at either end of it. The general arrangement of the appliance, is shown in Fig. 12 and, is capable of heating pipes up to 2 in. in diameter, while a larger appliance provided with two burners each firing in a separate opening is capable of dealing with pipes up to 4 in. in diameter.

Examples of the use of the Hypact burner in the heating of oven or muffle furnaces are comparatively few. A notable instance, however, is a furnace which employed a No. 60 Hypact burner made from silicon-ester-bonded zircon operating at a pressure of 5 p.s.i.g. The burner fired obliquely upwards under one side of the roof arch of the working chamber measuring 12 in. by 12 in. by 6 in., and was supplied with preheated air from a recuperator fed from two openings, one above and one below the burner. The flame was of great intensity and was capable of raising the temperature of the working chamber to 2,000°C.

The internal heating of rollers is another field in which the Hypact burner has been successfully employed. It calls for a flame of small size and of high stability with the expectation of long running periods without servicing.

Gas burners previously used for such work were generally of the post-aerated type, but the high heat input required to heat the roller initially meant that a large number of small burners were needed and so bulky burner sets difficult to install were the result; further after the initial heating, the gas rate had to be reduced to a low level and yet to remain stable in spite of the rotation of the roller. The use of the Hypact burner has solved both these problems.

In catering equipment the Hypact burner has had limited application up to the present but, one appliance of interest though unlikely to be repeated, was specifically made for the cooking of chapatti. In Pakistan the method of cooking these unsweetened pancakes made with a flour and water batter is to press the wet mixture spread on a former on to the clay-lined wall of a circular pit dug in the ground; this operation is carried out after the fire which had been burning at the base of the pit, had been allowed to die down.

The Hypact burner was successfully used in this appliance since it met all the requirements in that it was small and gave a stable flame during rapid variations in gas rate; the burner needs to have a flame capable of radiating over a wide area, and it must be able to work for long periods without attention because of its inaccessibility.

The articles adhere to the walls and receive heat from them as well as radiation from the embers of the fire. In order to reproduce these conditions an insulated tapered cylindrical oven was made with a single Hypact burner positioned centrally in the base, and the products of combustion discharged from openings in the removable lid. In operation the unit was brought up to temperature, the lid removed and the gas rate was reduced while the oven was loaded.

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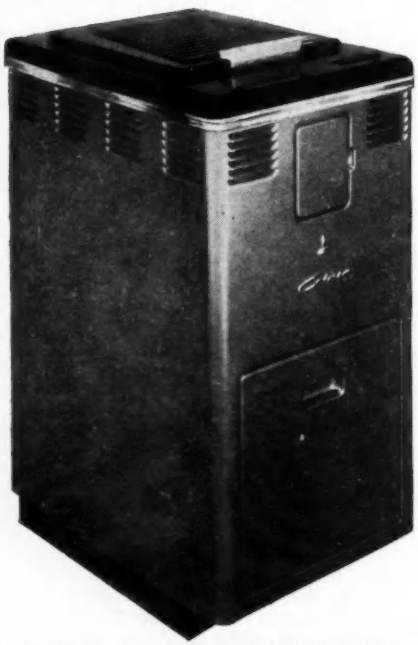

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a Subsidiary Company of
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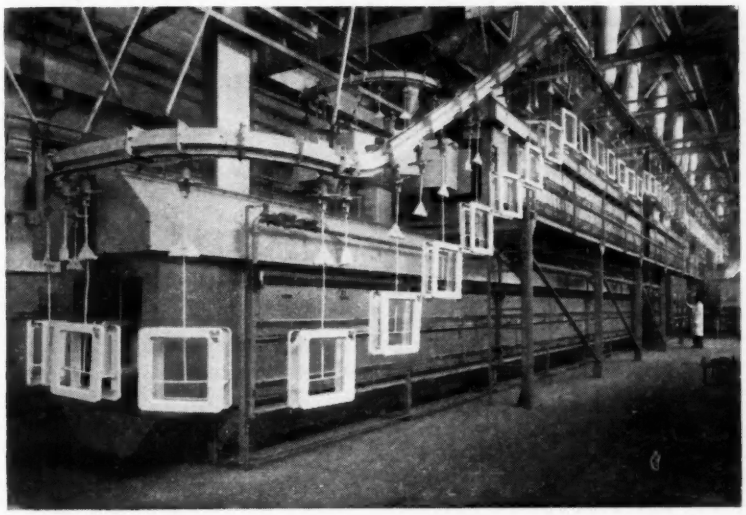


◀ Fig. 1.

Gas-fired infra red ovens

A STRIKING example of the use of town gas in industry can be seen in a recent installation at the works of a company in the A.E.I. Group, Hotpoint Ltd., at Llandudno.

The problem was to give continuous drying of components, large and small, for a rapidly growing production of washing machines, which included the machine body and such components as wringers, top covers, etc.

Space is often at a premium, and in this case the economic use of space and of applied work study led the engineers of customer and contractor to consider two-decker ovens in tandem, the top ovens being supported by a gantry.

High level space

With the tendency in industry to waste space at high level, this arrangement appealed to the customer. The space normally occupied by four ovens has been reduced by 50% by siting the finish coat ovens over the primer coat ones.

One of the most expensive cumulative operations in production is the simple one of transportation—transportation from press to press, from press to degreasing, etc. Cut out handling charges and real economies are to be made. The conveyorised plant as in this product finishing shop certainly leads to economies.

Fig. 1 shows an infra red drying oven for the cabinet plant—primer and finish coat—made up of 198 panels 100 ft. long on the lower deck and 156 panels 78 ft. long on the upper deck, operating at a temperature of 500°F., giving a stoving time of about 12½ minutes.

180 cabinets per hour

At the time of installation, this was handling 180 cabinets per hour. Both the primer coat and finishing coat are applied in an electrostatic paint-spraying unit and, together with the drying ovens, form a continuous circuit finishing at a point where the components are transferred to a storage conveyor prior to final assembly.

Fig. 2 shows the master controller panel to which temperatures are relayed back from the ovens by thermostatic means.

The use of pyrostats for thermostatic control can reduce running costs by as much as 20%. Pyrostats are incorporated in all the units installed with this equipment.

Advantages of this type of control are:

1. Ease of control of temperatures on each bank of infra red panels.
2. Reduction in running costs.
3. Ovens switched on to bypass during short shut-down periods, lunch breaks, breaks between shifts and during a change in production programme.

Gas infra red ovens are contributing to the speedy production of countless articles and, in addition to the reduction in space, give a high quality finish to the product.

The installation of the oven was by Parkinson Cowan Industrial Products in association with H. R. Noble, Ltd.

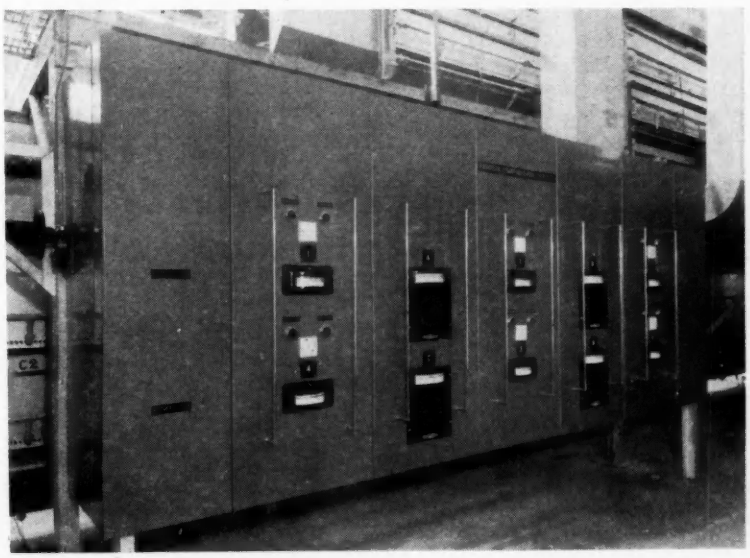


Fig. 2. ▶

FACTORY KITCHENS

THE SECOND OF A NEW SERIES BY 'GASTRONOME' ON INDUSTRIAL CANTEENS AND HOW THEY CAN BE PLANNED

OF the two kinds of factory kitchen design mentioned in the first of this series, we have established that the 'open' kitchen can normally operate with a smaller staff than the 'divided,' and that it needs less cleaning time, less maintenance, and less capital outlay. Above all, it is easier to operate in many respects.

Factory kitchen work is one of the most arduous of crafts. Whatever the problems, the meal must be presented at a pre-determined time since the whole organisation of the factory depends on it. The open design kitchen lends itself towards this end.

Divided kitchen for 1,000 up

This is not to say that the divided kitchen cannot fulfil all that is required of it; it can quite easily do so, but it should be reserved for establishments catering for 1,000 or more.

The open kitchen illustrated here is capable of cooking for 300 persons. It is typical of many post-war kitchens and it is interesting to compare it with the other type and observe the advantages and shortcomings of each.

Island site

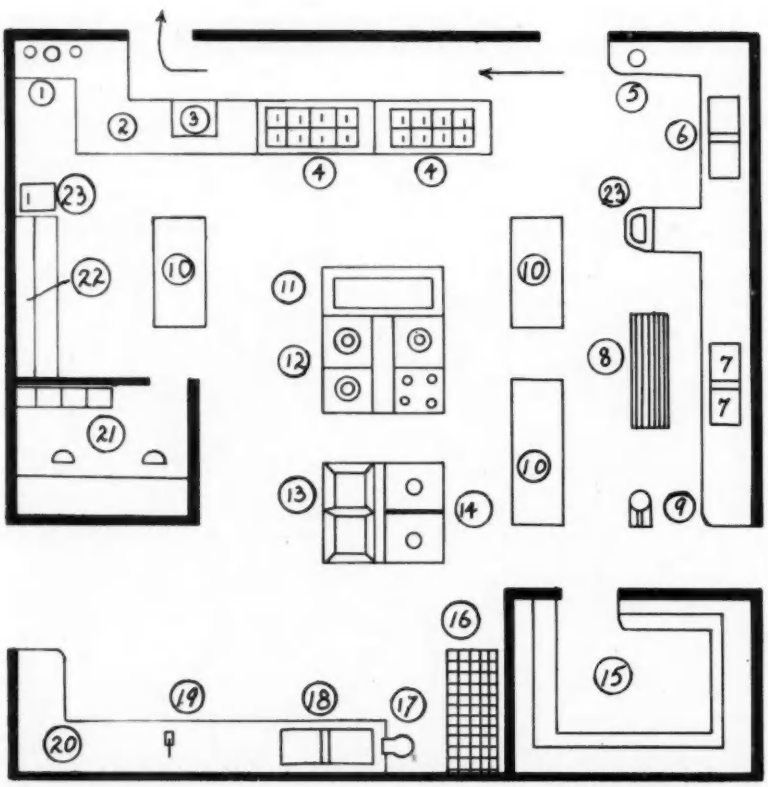
This open design gives a central or island site consisting of a four-oven gas range with a conventional open bain marie at one end for the transit of cooked food from the range to the serving hot-cupboard. On a second island site are placed a double-pan deep-fat frying range and two steaming ovens. This arrangement allows easy movement around the cooking assembly and the considerable saving in movement essential in kitchens, particularly where women cooks are employed.

From this assembly, the hub of the kitchen, all the preparation benches and tables, the crockery and pan wash-up areas can be seen. Indeed the only parts of the kitchen that are screened from view are, for reasons of security, the dry stores and abundant shelf space and, for reasons of security, privacy and discipline, the office accommodation.

The result of this kind of layout is that all processes and operations can be seen and that the kitchen staff can work as a team in all their different tasks.

Staff for 300-meal kitchen

For a kitchen designed to supply 300 meals the staff needed is one head cook, two assistant cooks, four kitchen and counter assistants, and one washer-up. The counter assistants' duties are to make and serve beverages, serve all food from the counter



OPEN KITCHEN

1. Beverage set.
2. Cold counter.
3. Display unit.
4. Hotcupboard and fitted bain marie.
5. Water waste disposer.
6. Washing-up machine.
7. Pot sinks.
8. Pot rack.
9. General purpose mixer.
10. Preparation tables.
11. Open bain marie.
12. Four-oven gas range.
13. Two-unit deep-fat fryer.
14. Two steaming ovens.
15. Dry stores.
16. Vegetable racks.
17. Potato machine.
18. Vegetable sinks.
19. Chipping machine.
20. Vegetable preparation.
21. Office.
22. Preparation bench and cupboard.
23. Salamander.

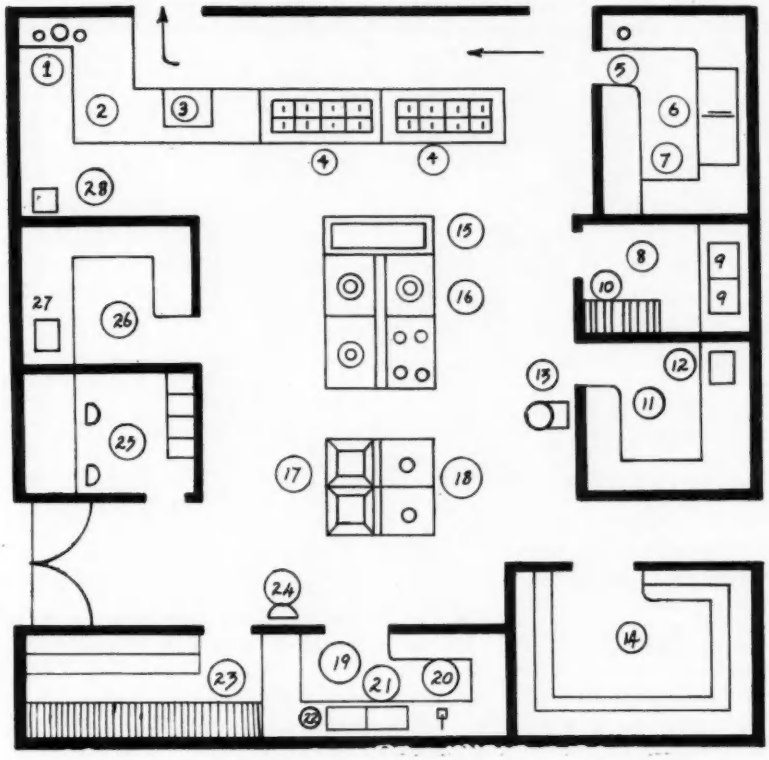
23a. Hand basin.

(Cold room is immediately adjacent to kitchen).

PARTITIONED KITCHEN

1. Beverage set.
2. Cold counter.
3. Display unit.
4. Hotcupboard and fitted bain marie.
5. Water waste disposer.
6. Washing-up machine.
7. Dish washing room.
8. Pot wash room.
9. Pot sinks.
10. Vegetable rack.
11. Pastry room.
12. Glazed sink.
13. General purpose mixer.
14. Dry store.
15. Open bain marie.
16. Four-oven gas range.
17. Two-unit deep-fat fryer.
18. Steaming ovens.
19. Vegetable preparation room.
20. Chipping machine.
21. Vegetable sinks.
22. Potato machine.
23. Vegetable store.
24. Hand basin.
25. Office.
26. General preparation.
27. Glazed sink.
28. Salamander.

(Cold room is immediately adjacent to kitchen).



bain maries and to help in all kitchen work in general. A 400-meal kitchen would require four cooks, five assistants and one washer-up and as the number increases to 450 another washer-up would be needed and at 500 another kitchen assistant. It can be seen that the open kitchen keeps the number of cooks required to a minimum and also reduces the work of cleaning walls, corners and extra lengths of preparation benches.

Divided kitchens

Now let us consider the divided kitchen. It has exactly the same amount and kind of gas cooking and food service equipment (which, incidentally, is adequate for the provision of 300-350 varied menu meals or 400 with a choice of two main dishes).

The partitioned areas are for crockery washing, pan washing, pastry preparation, meat and fish preparation and for the essential dry stores and office. Normally these require staffing by specialist cooks, making four cooks in addition to the head cook and a total of seven assistants. On such a basis the design is hardly worth considering and indeed partitions separating the different sections can only be justified for numbers of 1,000 or more.

It is recommended, therefore, that kitchens are of the open design.

Careful specification

The amount of equipment, both for cooking and preparation, that is required, should be carefully specified. Far too many kitchens have excess equipment which waste capital and space, and results in excessive running costs. Table 1 shows basic appliance needs for industrial kitchens serving a choice of several main and sweet courses. Keep to this schedule and good results will be obtained—but do remember that the *right* equipment to install is the *best* equipment.

Dimensions of average unit

For the purposes of this schedule an average oven unit would be one with a dimension of approximately 24 in. wide by 24 in. high by 21 in. deep with a hot plate approximately 30 in. by 30 in. and a steaming oven of 6-8 cu.ft. capacity With the boiling water appliances this capacity should be available within a given 20 minutes.

Items such as pastry ovens can be considered when cakes and high-class

TABLE I—BASIC EQUIPMENT NEEDS

Meals served at one sitting	Oven plus hotplate units (average)	Deep fryer units	Steaming ovens	Grills or salamanders	Hot cupboards with bain marie tops	Boiling water capacity (pints)	Coffee/ milk capacity (pints)	Dish washer (pieces (per hour)
100	2	1	–	1 small	6	60	30	500
150	2	1	1	1 small	8	80	50	750
200	3	1	1	1 large	10′	100	70	1,000
250	3	2	1	1 large	12′	120	80	1,250
300	4	2	2	1 large	12′	150	100	1,500
380	4	2	2	1 large	12	180	120	1,750
400	5	2	2	2 large	15	200	140	2,000
500	6	2	2	2 large	18	240	160	2,500

TABLE II—PREPARATION EQUIPMENT NEEDS

	Potato peeling machine (lbs.)	General purpose mixer (quarts)	Meat slicing machine	Potato chipping machine
100	7	12	1 hand	1 hand
150	14	12	1 hand	1 hand
200	14	12	1 power	1 power
250	14	20	1 power	1 power
300	14	20	1 power	1 power
350	28	25	1 power	1 power
400	28	30	1 power	1 power
450	28	40	1 power *1 hand	1 power
500	28	40	1 power *1 hand	1 power

pastry are cooked in the kitchen. Do not reduce the number of cooker units except in the 400 class, where the number could be four instead of five.

Kitchen furnishing

This information should establish a basis for re-designing and re-equipping a kitchen. The next contribution in this series will discuss kitchen furnishing and enlarge upon the gas cooking and food service equipment available.

SWITCH TO GAS

Three more giant bottle ovens in the Potteries are to disappear from the skyline. They are at the Spode works of W. T. Copeland & Sons Ltd., who have now switched to an all-gas kiln. The new kiln is a tunnel 138 ft. long, capable of firing three times more biscuit bone china than the present quantity produced.

Exhibition shows pottery kiln developments

EXHIBITS on the West Midlands Gas Board's stand at the North Staffordshire Chamber of Commerce golden jubilee industrial exhibition being held at Stoke-on-Trent until June 4, illustrate the striking development in recent years of the use of gas for industrial heating processes, particularly in pottery manufacture.

First introduced in the 1930s, gas-fired kilns are now commonplace in the Potteries, where they have replaced hundreds of the old-fashioned bottle kilns.

There is on show a full-sized cross-section of a multi-passage kiln and a model of an intermittent truck type kiln.

They are examples of several types of kilns specially developed by the W.M.G.B. for use in the pottery trade, capable of firing anything from flower pots to fine china.

SAFE Level Indication of Liquefied Inflammable Gases

The Ekstrom liquid level indicator eliminates the hazards normally associated with the level indication of liquefied inflammable gases under pressure because all liquid is confined to metal housings. Accidental breakage of the glass indicator tube does not release process liquid nor impair the efficiency of the various alarm devices which are available.

The Ekstrom liquid level indicator shown here is indicating the level of liquid butane in a storage tank at the Luton works of Messrs. Vauxhall Motors Ltd.

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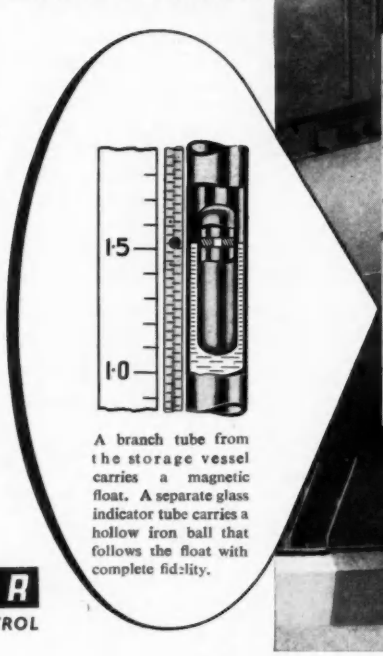
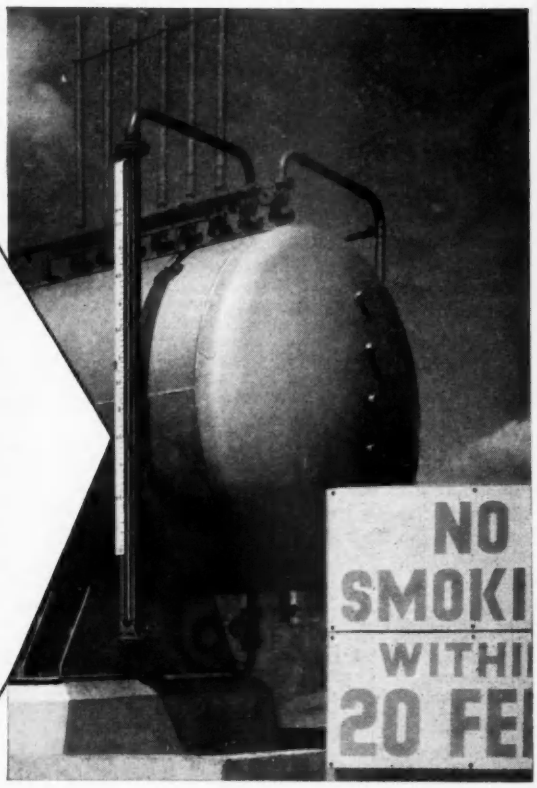


A branch tube from the storage vessel carries a magnetic float. A separate glass indicator tube carries a hollow iron ball that follows the float with complete fidelity.



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